MEMORANDUM

TO: Dwight Leisle, Port of Portland
Herb Clough, Apex Companies, LLC

FROM: Mark Dunn Lewis, Formation Environmental, LLC

DATE: September 17, 2014

SUBJECT: Evaluation of 2014 Soil Samples from the Willamette Cove Upland Site for Potential Impacts on Residual Risk Assessment Findings

---

Residual Risk Assessments (RRAs) were completed for the Willamette Cove Upland Facility in December 2013 (Formation Environmental 2013 and 2014), and approved by Oregon Department of Environmental Quality (DEQ) on May 28, 2014. During Spring 2014, DEQ directed the Port to collect additional soil samples from the Facility to support the Feasibility Study. The samples were analyzed for metals, polycyclic aromatic hydrocarbons (PAHs), and polychlorinated dibenzodioxins/furans (PCDD/Fs). Chemicals from each of these groups were included in the Contaminants of Concern (COCs) identified in the RRAs. Initial review of the chemical analysis from these samples led DEQ to request that the Port evaluate the potential effects of the new data on conclusions of the risk assessments. This memorandum provides the evaluation by comparison of the data used to estimate exposures in the RRA, to the data collected in 2014. This analysis is not intended to characterize exposure and risk, only to document relative differences in the concentrations, and comment on how these might change the risk estimates.

The 2014 soils sampling at Willamette Cove was conducted in four iterations, with locations and results described in the following documents from Apex Companies:

- Incremental Surface Soil Sampling Results, Willamette Cove Upland Facility (March 4, 2014) (Apex 2014a);
- Surface Soil Sampling Results - DU-6, Willamette Cove Upland Facility (June 16, 2014) (Apex 2014b); and
- Surface Soil Sampling – Remedial Design, Willamette Cove Upland Facility (May 15, 2014) (Apex 2014c).

Initial 2014 sample collection was conducted in February and included four incremental sampling method (ISM) composites. Each ISM sample was comprised of between 42 to 50 subsamples. One ISM sample was collected from the East Parcel (Decision Unit [DU]-4), and one from the West Parcel (DU-7). Two ISM composites were collected from the Central Parcel; one from DU-5 in the western portion of the Central Parcel and one from DU-6 in the eastern portion (Apex 2014a). Elevated concentrations of dioxins/furans and mercury in samples led DEQ to request two additional rounds of sampling from DU-6 to help characterize distribution of these chemicals in the DU (Apex 2014b). The first round included 4 ISM composites, each of which was comprised of subsamples collected from cells within the DU. The second round included 9 composites (created from the DU-6 ISM discrete samples) and 12 discrete samples from DU-6. Mercury also was analyzed in each of the cells from each of the composited areas (i.e., mercury analyses are all from discrete samples, not composited among cells).

Additional soil sampling was conducted in 2014 to better delineate areas of the site targeted for potential removal actions (Apex 2014c). This sampling focused on six areas of the site; one in the West Parcel, and five in the Central Parcel. All samples resulting from this effort were discrete samples (i.e., not composites). In most cases, the delineation samples were intended to help delineate areas around previous sampling locations at which unacceptable COC concentrations were known, but for which data were not sufficient to delineate remediation areas. Therefore, in the following analysis, samples from the 2014 remedial delineation were assumed to replace the data from previous (pre-2014) sampling.

The RRA included separate exposure and risk analyses for five exposure units (EUs). The Inner Cove Beach EU and the Central Beach EU were not sampled in 2014 because they are not in the Upland Facility and are not being addressed as part of the Feasibility Study. Samples were collected in 2014 from the West Parcel EU, Central Parcel EU, and East Parcel EU. As a result, the evaluation presented below is restricted to these three EUs and focuses on the chemicals highlighted in the ISM and delineation sampling.

West Parcel EU

Results for the West Parcel are shown in Table 1. Sampling conducted in 2014 for the West Parcel was restricted to one ISM sample, as well as multiple discrete samples associated with delineation of Area 1 which were analyzed for only mercury.

The maximum mercury concentration in the delineation samples, 0.271 mg/kg, was substantially lower than the previous maximum of 3.5 mg/kg from location TP3 (Apex 2014c). The new maximum concentration is lower than the site-specific RBC for ecological receptors of 0.3 mg/kg. If the delineation data were used to replace the pre-2014 data in the RRA, mercury would not be a COC for ecological receptors. However, the mercury concentration in the parcel ISM sample was 0.357 mg/kg, which is slightly higher than the site-specific ecological RBC.

The Human Health RRA did not identify mercury as a potential COC for the West Parcel, and mercury would also remain off the COC list for human health because the maximum concentration is substantially below the lowest human-health-based RBC listed by DEQ (2012) of 23 mg/kg (for residential scenario).

Concentrations of the PAHs benzo(a)pyrene and fluoranthene in the ISM sample exceed the site-specific human health RBC (based on the Future Park User scenario). As a result, the overall benzo(a)pyrene equivalents (BaPEq) concentration also exceeds the site-specific RBC. This result is consistent with the result of the Human Health RRA which identified PAHs as a COC.

The overall PCDD/F concentration, expressed in 2,3,7,8-tetrachlorodibenzo dioxin equivalents (TCDD-Eq) exceeds the human health-based RBC. The exceedance is primarily due to concentrations of penta- and hexa-chlorodibenzodioxins. PCDD/Fs data were not available from the West Parcel for the RRA, so no previous risk analysis is available prior to the availability of the 2014 data.

Central Parcel EU

Comparison of 2014 data and RRA data are shown in Table 2. Due to the more extensive characterization of the DU-6 area, substantially more samples were collected in 2014 than for the other parcels and so a larger range of comparisons is possible.

Among the metals, mercury was the only metal for which the maximum concentration from the 2014 discrete samples (74.2 mg/kg) was substantially different than the previous maximum from the Central Parcel (20.2 mg/kg). The new maximum was collected from removal action Area 3 (Apex 2014c), which approximately coincides with the eastern end of DU-6. No metals data from ISM samples were available prior to the 2014 sampling, and no other composites were collected in 2014. In the ISM samples from 2014, mercury ranged from 7 mg/kg in the DU-5 sample to 11 in the DU-6 sample (although both of these samples were analyzed outside laboratory hold times and are qualified, Apex 2014a).

Mercury was identified as a COC for ecological receptors in the RRA. Therefore, the higher maximum from 2014 data does not change the conclusions about ecological risk from mercury in the Central Parcel EU.

Mercury was not identified as a COC for human health risk based on the RRA, and no site-specific RBC was calculated based on the site risk scenarios. The new maximum concentration from discrete samples exceeds DEQs RBC (DEQ 2012) for the urban resident (47 mg/Kg). However, the maximum ISM sample result (11 mg/kg) does not exceed the DEQ RBC, and neither maximum discrete nor ISM concentrations would exceed hot spot values based on the DEQ RBC. Based on the ISM samples, mercury would not be a COC for human health in the Central Parcel.

The RRA identified arsenic as a potential COC in the Central Parcel for human health (based on the Future Park User scenario) based on potential carcinogenic effects. The maximum discrete sample from the Central parcel (40.3 mg/kg) exceeds the RBC for the Future Park User (8.8 mg/kg), but the concentrations in ISM samples is below the RBC suggesting that parcel-wide risk may be acceptable.

Samples for PAHs were collected during ISM sampling and for the Remedial Design sampling in 2014. Among the PAHs evaluated, maximum concentrations of discrete samples increased for five PAHs, and decreased for 13. The decreases were typically on the order of 2-5 fold; increases ranged from 2 to 11-fold. Total PAH concentration and total BaPEq were both lower.

Individual PAHs, and BaPEq were identified as COCs for human health, and high molecular weight PAHs (HPAHs) were identified as COCs for ecological receptors. In all cases, the updated 2014 concentrations remain above the site-specific RBCs calculated for the Future Park User and the ecological receptors, so the fundamental conclusions about risk from PAHs does not change.

Samples for PCDD/Fs were collected during ISM sampling in all three parcels in 2014. PCDD/F data were historically available for the RRA only from the Wharf Road Area (i.e., DU-1, DU-2, and DU-3), as well as some composite and discrete samples from the nearby riverbank area. The most recent round of 'ISM' sampling included variations on the compositing approach. As a result, samples are identified as 'composites' in sampling reports (Apex 2014b). Discrete samples for PCDD/Fs are also available from some cells in the DU-6 sampling area.

In general, higher concentrations of PCDD/Fs were observed in all sample types from the DU-6 area than were previously observed from the Wharf Road area and riverbank sampling. PCDD/Fs were identified as COCs in the RRA for both human and ecological receptors. Concentrations in 2014 samples have generally higher concentrations than previous samples from the Wharf Road area. Since the pre-2014, concentrations exceed RBCs for both human (Future Park User) and ecological receptors, the 2014 data do not fundamentally change conclusions about environmental risk from PCDD/Fs in the Central Parcel. However, the 2014 data indicate wider distribution of PCDD/Fs concentrations that exceed RBCs in the Central Parcel.

East Parcel EU

Results for the East Parcel are shown in Table 3. Sampling conducted in 2014 for the West Parcel and East Parcel was restricted to one ISM sample each.

For the East Parcel, one discrete sample was collected as part of the delineation sampling for Area 6. Concentrations in this sample only marginally changed the overall results for mercury and fluorene. The maximum concentration for mercury increased from 1.1 mg/kg in pre-2014 data to 1.4 mg/kg. The overall ISM concentration for the East Parcel (DU-4) was 0.05 mg/kg which is substantially below the

site-specific risk based concentration (RBC) for ecological receptors (0.3 mg/kg). Mercury was not identified as a COC for human health in the East Parcel.

Fluorene maximum concentration was reduced from 0.782 to 0.745 mg/kg. The reduction reflects replacement of pre-2014 data with the 2014 delineation sample for Area 6 that was taken from the East Parcel. Fluorene is not one of the carcinogenic PAHs, and no RBC is available from DEQ (2012), nor was it identified as a COC in the RRA.

The ISM sample for the East Parcel contained concentrations of antimony, lead, zinc, and TCDD-Eq that exceed the site-specific RBCs for ecological receptors. Of these, TCDD -Eq was not identified as a COC in the Ecological RRA (See Table 5.1 in the Ecological RRA). Chromium, copper, and nickel were also identified as COCs in the RRA, but the ISM sample did not exceed the ecological RBC.

The ISM sample contained concentrations of benzo(a)pyrene, fluoranthene, BapEq, and TCDD-Eq that exceeded the site-specific human health RBCs. Except for the TCDD-Eq, this result is consistent with the RRA results (See Table 5-3-2 in the Human Health RRA). The RRA also identified Aroclors (i.e., polychlorinated biphenyls) as a potential COC, but Aroclors were not analyzed in ISM samples (Apex 2014 a, b, c).

Conclusions

Overall, the results of the 2014 soil sampling and analysis do not change the conclusions of the Human Health or Ecological Risk Assessment. Concentrations of PCDD/Fs were found to be more widely distributed and with higher maximum concentrations, particularly in the Central Parcel, but PCDD/Fs were already identified as a COC for both human and ecological receptors at the site. Similar results were observed for mercury, where maximum concentrations appear to be higher, but overall conclusions about whether mercury should be a COC do not change.

In some cases, like mercury in the West Parcel, or arsenic in the East Parcel, risks based on ISM samples appear to be lower than were predicted by data available for the RRA. However, alternative conclusions about these chemicals is not likely to change the overall remediation approach in the Feasibility Study for the Facility.

References Cited

Apex Companies. 2014a. Incremental Surface Soil Sampling Results, Willamette Cove Upland Facility (March 4, 2014).

Apex Companies. 2014b. Surface Soil Sampling Results - DU-6, Willamette Cove Upland Facility (June 16, 2014).

Apex Companies. 2014c. Surface Soil Sampling – Remedial Design, Willamette Cove Upland Facility (May 15, 2014).

DEQ (Oregon Department of Environmental Quality). 2012. Risk-based Concentrations for Individual Chemicals. June 7, 2012.

Formation Environmental. 2013. Residual Human Health Risk Assessment, Willamette Cove Upland Facility. December 2013.

Formation Environmental. 2014. Ecological Risk Assessment, Residual Risk Assessment, Willamette Cove Upland Facility. January 2014.

Table 1. West Parcel Baseline/Residual Risk Assessment Data, with 2014 Updates (all units in mg/Kg)

Chemical of Concern	Baseline/Residual Risk Assessment								Baseline/Residual Risk Assessment, plus 2014 samples (but not including results superceded by newer data from co-located Area samples)						Preliminary Remediation Goals	
	Overall		Discrete Samples		Composite Samples		ISM Samples		Discrete Samples		Composite Samples		ISM Sample		Lowest Ecological PRG	Human: Future Park User PRG
	Minimum Detected Value	Maximum Detected Value	Minimum Detected Value	Maximum Detected Value	Minimum Detected Value	Maximum Detected Value	Minimum Detected Value	Maximum Detected Value	Minimum Detected Value	Maximum Detected Value	Minimum Detected Value	Maximum Detected Value	Minimum Detected Value	Maximum Detected Value		
Antimony	--	--	--	--	--	--	--	--	--	--	--	--	--	--	2.7	24.3
Arsenic	2.63	5.36	2.63	5.36	--	--	--	--	2.63	5.36	--	--	--	4.52		8.8
Beryllium	--	--	--	--	--	--	--	--	--	--	--	--	--	1.09		
Cadmium	--	--	--	--	--	--	--	--	--	--	--	--	--	0.337	5.1	
Chromium	13.7	20.6	13.7	20.6	--	--	--	--	13.7	20.6	--	--	--	19.2	76	
Copper	18.5	31	18.5	31	--	--	--	--	18.5	31	--	--	--	102	70	
Lead	9.81	95	9.81	95	--	--	--	--	9.81	95	--	--	--	43	79	904
Mercury	3.5	3.5	3.5	3.5	--	--	--	--	0.271	0.271	--	--	--	0.359	0.3	
Nickel	16.5	24	16.5	24	--	--	--	--	16.5	24	--	--	--	15.4	47	
Selenium	--	--	--	--	--	--	--	--	--	--	--	--	--	--		
Silver	--	--	--	--	--	--	--	--	--	--	--	--	--	--		
Thallium	--	--	--	--	--	--	--	--	--	--	--	--	--	--		
Zinc	71.1	173	71.1	173	--	--	--	--	71.1	173	--	--	--	151	180	
Acenaphthylene	0.152	0.243	0.152	0.243	--	--	--	--	0.152	0.243	--	--	--	0.0189		
Acenapthene	--	--	--	--	--	--	--	--	--	--	--	--	--	0.0164		
Anthracene	0.0353	0.102	0.0353	0.102	--	--	--	--	0.0353	0.102	--	--	--	0.0387		
Benzo(a)anthracene	0.0737	0.295	0.0737	0.295	--	--	--	--	0.0737	0.295	--	--	--	0.187		0.497
Benzo(a)pyrene	0.1	0.927	0.1	0.927	--	--	--	--	0.1	0.927	--	--	--	0.313		0.0497
Benzo(b)fluoranthene	0.0919	0.726	0.0919	0.726	--	--	--	--	0.0919	0.726	--	--	--	0.265		0.497
Benzo(k)fluoranthene	0.0829	0.802	0.0829	0.802	--	--	--	--	0.0829	0.802	--	--	--	0.252		
Benzo(g,h,i)perylene	0.0938	0.915	0.0938	0.915	--	--	--	--	0.0938	0.915	--	--	--	0.238		
Chrysene	0.0893	0.554	0.0893	0.554	--	--	--	--	0.0893	0.554	--	--	--	0.255		
Dibenzo(a,h)anthracene	0.0266	0.159	0.0266	0.159	--	--	--	--	0.0266	0.159	--	--	--	0.0669		0.0497
Fluoranthene	0.105	0.727	0.105	0.727	--	--	--	--	0.105	0.727	--	--	--	0.508		
Fluorene	--	--	--	--	--	--	--	--	--	--	--	--	--	0.0136		
Methylnapthalene	--	--	--	--	--	--	--	--	--	--	--	--	--	--		
Naphthalene	0.228	0.228	0.228	0.228	--	--	--	--	0.228	0.228	--	--	--	0.0101		
Phenanthrene	0.0473	0.409	0.0473	0.409	--	--	--	--	0.0473	0.409	--	--	--	0.141		
Pyrene	0.104	0.716	0.104	0.716	--	--	--	--	0.104	0.716	--	--	--	0.26		
Total BaPEq	0.1171532	1.267134	0.1171532	1.267134	--	--	--	--	0.7712	1.267134	--	--	--	0.442675		0.0497
Total PAHs	0.7712	7.105	0.7712	7.105	--	--	--	--	0.7712	7.105	--	--	--	2.73946	5.6	
Indeno(1,2,3-cd)pyrene	0.0704	0.724	0.0704	0.724	--	--	--	--	0.0704	0.724	--	--	--	0.148		
Dioxin/furan TCDD toxicity equivalent (ND = 0)	--	--	--	--	--	--	--	--	--	--	--	--	--	1.03E-04	1.95E-05	1.13E-05
2,3,7,8-TCDF	--	--	--	--	--	--	--	--	--	--	--	--	--	5.45E-06	1.30E-04	1.13E-04
2,3,7,8-TCDD	--	--	--	--	--	--	--	--	--	--	--	--	--	2.11E-06	1.95E-05	1.13E-05
1,2,3,7,8-PeCDF	--	--	--	--	--	--	--	--	--	--	--	--	--	8.02E-06	4.31E-04	3.75E-04
2,3,4,7,8-PeCDF	--	--	--	--	--	--	--	--	--	--	--	--	--	4.92E-06	3.35E-05	3.75E-05
1,2,3,7,8-PeCDD	--	--	--	--	--	--	--	--	--	--	--	--	--	3.86E-05	5.67E-05	1.13E-05
1,2,3,4,7,8-HxCDF	--	--	--	--	--	--	--	--	--	--	--	--	--	1.89E-05	2.29E-05	1.13E-04
1,2,3,6,7,8-HxCDF	--	--	--	--	--	--	--	--	--	--	--	--	--	8.47E-06	2.29E-05	1.13E-04
2,3,4,6,7,8-HxCDF	--	--	--	--	--	--	--	--	--	--	--	--	--	7.40E-06	2.29E-05	1.13E-04
1,2,3,7,8,9-HxCDF	--	--	--	--	--	--	--	--	--	--	--	--	--	1.18E-06	4.52E-05	1.13E-04
1,2,3,4,7,8-HxCDD	--	--	--	--	--	--	--	--	--	--	--	--	--	1.34E-05	5.30E-05	1.13E-04
1,2,3,6,7,8-HxCDD	--	--	--	--	--	--	--	--	--	--	--	--	--	2.85E-04	2.30E-05	1.13E-04
1,2,3,7,8,9-HxCDD	--	--	--	--	--	--	--	--	--	--	--	--	--	1.70E-04	2.30E-05	1.13E-04
1,2,3,4,6,7,8-HpCDF	--	--	--	--	--	--	--	--	--	--	--	--	--	1.72E-04	3.83E-04	1.13E-03
1,2,3,4,7,8,9-HpCDF	--	--	--	--	--	--	--	--	--	--	--	--	--	6.74E-06	3.83E-04	1.13E-03
1,2,3,4,6,7,8-HpCDD	--	--	--	--	--	--	--	--	--	--	--	--	--	6.72E-04	3.91E-04	1.13E-03
OCDF	--	--	--	--	--	--	--	--	--	--	--	--	--	2.19E-04	5.49E-03	3.75E-02
OCDD	--	--	--	--	--	--	--	--	--	--	--	--	--	2.86E-03	2.17E-02	3.75E-02

Yellow shading indicates 2014 concentration is HIGHER than that used in the Residual Risk Assessment
Grey shading indicates 2014 concentration is LOWER than that used in the Residual Risk Assessment
ISM Samples available for the Residual Risk Assessment included only samples from Wharf Road Area Decision Units (DU-1, DU-2, DU-3).

Table2. Central Parcel Baseline/Residual Risk Assessment Data, with 2014 Updates

Chemical of Concern	Baseline/Residual Risk Assessment								Baseline/Residual Risk Assessment, plus 2014 samples (but not including results superceded by newer data from co-located Area samples)						Preliminary Remediation Goals	
	Overall		Discrete Samples		Composite Samples		ISM Samples		Discrete Samples		Composite Samples		ISM Samples			
	Minimum Detected Value	Maximum Detected Value	Minimum Detected Value	Maximum Detected Value	Minimum Detected Value	Maximum Detected Value	Minimum Detected Value	Maximum Detected Value	Minimum Detected Value	Maximum Detected Value	Minimum Detected Value	Maximum Detected Value	Minimum Detected Value	Maximum Detected Value	Ecological: Lowest PRG	Human: Future Park User PRG
Antimony	0.21	29.9	0.27	29.9	0.21	4.9	--	--	0.27	29.9	0.21	4.9	1.29	1.29	2.7	24.3
Arsenic	1.76	40.3	1.76	40.3	3.3	12.1	--	--	1.76	40.3	3.3	12.1	4.95	6.02		8.8
Beryllium	0.19	3.33	0.25	3.33	0.19	0.5	--	--	0.25	3.33	0.19	0.5	0.678	0.679		
Cadmium	0.057	1.9	0.057	1.9	0.065	1.7	--	--	0.057	1.9	0.065	1.7	0.37	0.5	5.1	
Chromium	11	110	11	110	13.7	42.3	--	--	11	110	13.7	42.3	11.7	16.1	76	
Copper	15	5440	15	5440	22.2	2860	--	--	15	5440	22.2	2860	293	404	70	
Lead	2.57	4040	2.57	4040	13.8	1430	--	--	2.57	4040	13.8	1430	164	310	79	904
Mercury	0.033	20.2	0.077	20.2	0.033	5.5	--	--	0.077	74.2	0.033	5.5	7	11	0.3	
Nickel	14.2	144	17.2	144	14.2	69.5	--	--	17.2	144	14.2	69.5	14.7	16.6	47	
Selenium	0.096	1.8	0.096	1.8	0.75	1.5	--	--	0.096	1.8	0.75	1.5	--	--		
Silver	0.074	2.8	0.074	2.8	0.083	0.51	--	--	0.074	2.8	0.083	0.51	--	--		
Thallium	0.039	0.77	0.039	0.77	0.044	0.28	--	--	0.039	0.77	0.044	0.28	--	--		
Zinc	46.4	1460	46.4	1460	66.1	876	--	--	46.4	1460	66.1	876	187	238	180	
Acenaphthylene	1.20E-03	2.97E+00	1.20E-03	2.97E+00	1.40E-03	1.08E+00	--	--	1.20E-03	4.15E+00	1.40E-03	1.08E+00	4.20E-02	4.20E-02		
Acenapthene	2.10E-03	1.37E-01	2.10E-03	1.37E-01	6.70E-03	4.15E-02	--	--	2.10E-03	7.91E-01	6.70E-03	4.15E-02	9.79E-03	9.79E-03		
Anthracene	1.70E-03	8.65E+00	1.70E-03	8.65E+00	2.30E-03	1.29E+00	--	--	1.70E-03	6.45E+00	2.30E-03	1.29E+00	5.69E-02	5.69E-02		
Benzo(a)anthracene	4.60E-03	2.36E+01	4.60E-03	2.36E+01	1.38E-02	2.50E+00	--	--	4.60E-03	1.10E+01	1.38E-02	2.50E+00	1.62E-01	1.62E-01		0.497
Benzo(a)pyrene	5.90E-03	4.63E+01	5.90E-03	4.63E+01	2.01E-02	6.89E+00	--	--	5.90E-03	1.75E+01	2.01E-02	6.89E+00	2.88E-01	2.88E-01		0.0497
Benzo(b)fluoranthene	4.50E-03	2.75E+01	4.50E-03	2.75E+01	1.76E-02	5.74E+00	--	--	4.50E-03	2.26E+01	1.76E-02	5.74E+00	3.61E-01	3.61E-01		0.497
Benzo(k)fluoranthene	4.30E-03	2.42E+01	4.30E-03	2.42E+01	1.37E-02	5.83E+00	--	--	4.30E-03	1.62E+01	1.37E-02	5.83E+00	3.13E-01	3.13E-01		
Benzo(g,h,i)perylene	6.50E-03	4.43E+01	6.50E-03	4.43E+01	1.31E-02	2.62E+00	--	--	6.50E-03	2.08E+01	1.31E-02	2.62E+00	2.55E-01	2.55E-01		
Chrysene	4.10E-03	3.91E+01	4.10E-03	3.91E+01	1.64E-02	3.37E+00	--	--	4.10E-03	7.59E+00	1.64E-02	3.37E+00	2.92E-01	2.92E-01		
Dibenzo(a,h)anthracene	8.10E-04	9.13E+00	8.10E-04	9.13E+00	3.30E-03	1.28E+00	--	--	8.10E-04	2.81E+00	3.30E-03	1.28E+00	6.67E-02	6.67E-02		0.0497
Fluoranthene	7.30E-03	3.03E+01	7.30E-03	3.03E+01	1.83E-02	4.47E+00	--	--	7.30E-03	2.76E+01	1.83E-02	4.47E+00	5.30E-01	5.30E-01		
Fluorene	2.50E-03	3.70E-01	5.20E-03	3.70E-01	2.50E-03	1.74E-01	--	--	5.20E-03	2.16E+00	2.50E-03	1.74E-01	--	--		
Methylnapthalene	--	--	--	--	--	--	--	--	--	--	--	--	--	--		
Naphthalene	2.00E-03	1.07E+00	8.80E-03	1.07E+00	2.00E-03	2.14E-01	--	--	8.80E-03	1.10E+01	2.00E-03	2.14E-01	1.98E-02	1.98E-02		
Phenanthrene	3.90E-03	2.18E+01	3.90E-03	2.18E+01	6.80E-03	2.33E+00	--	--	3.90E-03	3.00E+01	6.80E-03	2.33E+00	1.36E-01	1.36E-01		
Pyrene	8.20E-03	5.21E+01	8.20E-03	5.21E+01	2.19E-02	4.29E+00	--	--	8.20E-03	3.50E+01	2.19E-02	4.29E+00	2.78E-01	2.78E-01		
Total BaPEq	8.02E-03	6.36E+01	8.02E-03	6.36E+01	2.78E-02	9.30E+00	--	--	8.02E-03	2.26E+01	2.78E-02	9.30E+00	4.28E-01	4.28E-01		0.0497
Total PAHs	5.65E-02	3.67E+02	5.65E-02	3.67E+02	1.62E-01	4.43E+01	--	--	5.65E-02	1.92E+02	1.62E-01	4.43E+01	3.00E+00	3.00E+00	5.6	
Indeno(1,2,3-cd)pyrene	3.50E-03	2.79E+01	3.50E-03	2.79E+01	1.06E-02	2.41E+00	--	--	3.50E-03	1.54E+01	1.06E-02	2.41E+00	1.72E-01	1.72E-01		
Dioxin/furan TCDD toxicity equivalent (ND = 0)	8.00E-05	5.70E-03	1.30E-04	5.70E-03	8.00E-05	8.00E-05	2.55E-04	7.73E-04	1.30E-04	5.36E-01	2.61E-05	4.60E-02	1.52E-04	7.73E-04	1.95E-05	1.13E-05
2,3,7,8-TCDF	1.34E-05	3.73E-05	--	--	5.00E-06	5.00E-06	1.34E-05	3.73E-05	2.46E-06	2.37E-04	7.37E-07	5.00E-06	5.91E-06	3.73E-05	1.30E-04	1.13E-04
2,3,7,8-TCDD	1.00E-06	2.40E-05	4.50E-06	2.40E-05	1.00E-06	1.00E-06	2.58E-06	6.45E-06	4.50E-06	1.04E-02	6.93E-07	7.72E-04	2.58E-06	6.45E-06	1.95E-05	1.13E-05
1,2,3,7,8-PeCDF	5.80E-06	4.56E-05	--	--	5.80E-06	5.80E-06	1.56E-05	4.56E-05	3.25E-06	1.61E-03	1.05E-06	1.24E-04	8.54E-06	4.56E-05	4.31E-04	3.75E-04
2,3,4,7,8-PeCDF	8.30E-06	1.60E-02	1.80E-04	1.60E-02	8.30E-06	8.30E-06	7.24E-05	1.59E-03	9.91E-06	1.60E-02	9.47E-07	2.41E-04	1.68E-05	1.59E-03	3.35E-05	3.75E-05
1,2,3,7,8-PeCDD	8.50E-06	2.40E-04	1.80E-05	2.40E-04	8.50E-06	8.50E-06	2.15E-05	8.48E-05	1.80E-05	2.18E-01	8.50E-06	1.93E-02	2.15E-05	8.48E-05	5.67E-05	1.13E-05
1,2,3,4,7,8-HxCDF	2.20E-05	1.40E-03	4.30E-05	1.40E-03	2.20E-05	2.20E-05	4.68E-05	2.55E-04	1.09E-05	9.15E-03	3.04E-06	8.98E-04	2.94E-05	2.55E-04	2.29E-05	1.13E-04
1,2,3,6,7,8-HxCDF	1.30E-05	2.80E-04	--	--	1.30E-05	1.30E-05	4.24E-05	2.80E-04	1.22E-05	1.21E-02	2.10E-06	1.22E-03	2.83E-05	2.80E-04	2.29E-05	1.13E-04
2,3,4,6,7,8-HxCDF	1.30E-05	3.20E-03	5.80E-05	3.20E-03	1.30E-05	1.30E-05	7.42E-05	6.52E-04	1.73E-05	1.31E-02	2.85E-06	1.35E-03	5.12E-05	6.52E-04	2.29E-05	1.13E-04
1,2,3,7,8,9-HxCDF	1.40E-05	1.00E-03	2.00E-05	1.00E-03	1.40E-05	1.40E-05	--	--	2.53E-06	1.26E-03	4.18E-07	1.62E-04	2.21E-06	2.21E-06	4.52E-05	1.13E-04
1,2,3,4,7,8-HxCDD	1.50E-05	1.50E-04	2.50E-05	1.50E-04	1.50E-05	1.50E-05	2.03E-05	5.30E-05	2.50E-05	8.96E-02	4.10E-06	4.83E-03	2.03E-05	5.30E-05	5.30E-05	1.13E-04
1,2,3,6,7,8-HxCDD	1.10E-04	6.80E-04	1.10E-04	6.80E-04	1.50E-04	1.50E-04	1.18E-04	6.59E-04	1.10E-04	1.69E+00	6.56E-05	1.45E-01	1.18E-04	6.59E-04	2.30E-05	1.13E-04
1,2,3,7,8,9-HxCDD	2.90E-05	4.30E-04	6.50E-05	4.30E-04	2.90E-05	2.90E-05	6.42E-05	3.33E-04	6.50E-05	9.49E-01	2.90E-05	8.13E-02	6.42E-05	3.33E-04	2.30E-05	1.13E-04
1,2,3,4,6,7,8-HpCDF	2.10E-04	2.30E-03	2.10E-04	2.30E-03	2.50E-04	2.50E-04	2.35E-04	4.49E-04	2.10E-04	4.54E-01	6.90E-05	5.62E-02	2.35E-04	4.49E-04	3.83E-04	1.13E-03
1,2,3,4,7,8,9-HpCDF	1.60E-05	3.40E-04	1.90E-05	3.40E-04	1.60E-05	1.60E-05	2.12E-05	7.38E-05	7.69E-06	6.84E-03	2.12E-06	6.72E-04	1.57E-05	7.38E-05	3.83E-04	1.13E-03
1,2,3,4,6,7,8-HpCDD	1.20E-03	3.16E-03	1.20E-03	2.40E-03	3.10E-03	3.10E-03	1.53E-03	3.16E-03	1.07E-03	2.54E+00	2.82E-04	1.80E-01	1.53E-03	3.16E-03	3.91E-04	1.13E-03
OCDF	2.40E-04	6.30E-04	2.40E-04	6.30E-04	4.90E-04	4.90E-04	3.10E-04	3.66E-04	--	--	--	--	--	--	5.49E-03	3.75E-02
OCDD	7.50E-03	2.70E-02	7.50E-03	1.30E-02	2.70E-02	2.70E-02	1.00E-02	1.88E-02	--	--	--	--	--	--	2.17E-02	3.75E-02

Yellow shading indicates 2014 concentration is HIGHER than that used in the Residual Risk Assessment
Grey shading indicates 2014 concentration is LOWER than that used in the Residual Risk Assessment
ISM Samples available for the Residual Risk Assessment included only samples from Wharf Road Area Decision Units (DU-1, DU-2, DU-3).

Table 3. East Parcel Baseline/Residual Risk Assessment Data, with 2014 Updates

Chemical of Concern	Baseline/Residual Risk Assessment								Baseline/Residual Risk Assessment, plus 2014 samples (but not including results superceded by newer data from co-located Area samples)						Preliminary Remediation Goals	
	Overall		Discrete Samples		Composite Samples		ISM Samples		Discrete Samples		Composite Samples		ISM Samples		Lowest Ecological PRG	Human: Future Park User PRG
	Minimum Detected Value	Maximum Detected Value	Minimum Detected Value	Maximum Detected Value	Minimum Detected Value	Maximum Detected Value	Minimum Detected Value	Maximum Detected Value	Minimum Detected Value	Maximum Detected Value	Minimum Detected Value	Maximum Detected Value	Minimum Detected Value	Maximum Detected Value		
Antimony	0.36	192	0.36	192	1.3	23.3	--	--	0.36	192	--	--	--	2.89	2.7	24.3
Arsenic	2.47	36.2	2.47	36.2	3.03	15.1	--	--	2.47	36.2	--	--	--	3.67		8.8
Beryllium	0.2	0.59	0.26	0.59	0.2	0.37	--	--	0.26	0.59	--	--	--	0.716		
Cadmium	0.12	1.7	0.45	0.75	0.12	1.7	--	--	0.45	0.75	--	--	--	0.368	5.1	
Chromium	4.45	145	4.45	145	13.5	61.8	--	--	4.45	145	--	--	--	11.4	76	
Copper	17.5	47500	18.6	47500	17.5	13500	--	--	18.6	47500	--	--	--	65.1	70	
Lead	1.49	3090	1.49	3090	11.6	1150	--	--	1.49	3090	--	--	--	201	79	904
Mercury	0.019	1.1	0.022	1.1	0.019	0.21	--	--	0.022	1.44	--	--	--	0.0541	0.3	
Nickel	16.1	306	16.1	306	17.6	73	--	--	16.1	306	--	--	--	13.9	47	
Selenium	0.11	1.3	0.11	0.54	0.71	1.3	--	--	0.11	0.54	--	--	--	--		
Silver	0.15	8.6	0.2	8.6	0.15	4.4	--	--	0.2	8.6	--	--	--	--		
Thallium	0.021	0.085	0.021	0.072	0.044	0.085	--	--	0.021	0.072	--	--	--	--		
Zinc	60.5	1810	60.5	1810	74.7	697	--	--	60.5	1810	--	--	--	221	180	
Acenaphthylene	0.0011	0.289	0.0361	0.289	0.0011	0.154	--	--	0.0361	0.289	--	--	--	0.0327		
Acenapthene	0.0042	0.0648	0.0095	0.0648	0.0042	0.0292	--	--	0.0095	0.0648	--	--	--	--		
Anthracene	0.0009	0.328	0.0271	0.328	0.0009	0.171	--	--	0.0271	0.328	--	--	--	0.0238		
Benzo(a)anthracene	0.0032	0.568	0.0163	0.568	0.0032	0.336	--	--	0.0163	0.568	--	--	--	0.0938		0.497
Benzo(a)pyrene	0.0052	0.589	0.0366	0.589	0.0052	0.512	--	--	0.0366	0.589	--	--	--	0.219		0.0497
Benzo(b)fluoranthene	0.0052	0.782	0.0427	0.782	0.0052	0.675	--	--	0.0427	0.782	--	--	--	0.195		0.497
Benzo(k)fluoranthene	0.0031	0.555	0.0325	0.555	0.0031	0.332	--	--	0.0325	0.555	--	--	--	0.165		
Benzo(g,h,i)perylene	0.0056	0.343	0.0316	0.335	0.0056	0.343	--	--	0.0316	0.335	--	--	--	0.156		
Chrysene	0.0047	0.803	0.0162	0.803	0.0047	0.449	--	--	0.0162	0.803	--	--	--	0.192		
Dibenzo(a,h)anthracene	0.00091	0.127	0.0147	0.127	0.00091	0.0856	--	--	0.0147	0.127	--	--	--	0.0414		0.0497
Fluoranthene	0.0046	0.745	0.0427	0.782	0.0046	0.507	--	--	0.0292	0.745	--	--	--	0.238		
Fluorene	0.0059	0.0808	0.0137	0.0808	0.0059	0.0391	--	--	0.0137	0.0808	--	--	--	--		
Methylnapthalene	--	--	--	--	--	--	--	--	--	--	--	--	--	--		
Naphthalene	0.003	0.506	0.064	0.506	0.003	0.421	--	--	0.064	0.506	--	--	--	0.00986		
Phenanthrene	0.0094	0.47	0.029	0.47	0.0094	0.313	--	--	0.029	0.47	--	--	--	0.0801		
Pyrene	0.0054	0.798	0.0261	0.798	0.0054	0.549	--	--	0.0261	0.798	--	--	--	0.151		
Total BaPEq	0.000031	0.885153	0.000031	0.885153	0.0073357	0.729369	--	--	0.000031	0.885153	--	--	--	0.303022		0.0497
Total PAHs	0.0261	7.3186	0.0261	7.3186	0.04651	5.0249	--	--	0.0261	7.3186	--	--	--	1.72417	5.6	
Indeno(1,2,3-cd)pyrene	0.0035	0.279	0.039	0.279	0.0035	0.269	--	--	0.039	0.279	--	--	--	0.119		
Dioxin/furan TCDD toxicity equivalent (ND = 0)	--	--	--	--	--	--	--	--	--	--	--	--	--	6.12E-05	1.95E-05	1.13E-05
2,3,7,8-TCDF	--	--	--	--	--	--	--	--	--	--	--	--	--	4.04E-06	1.30E-04	1.13E-04
2,3,7,8-TCDD	--	--	--	--	--	--	--	--	--	--	--	--	--	1.08E-06	1.95E-05	1.13E-05
1,2,3,7,8-PeCDF	--	--	--	--	--	--	--	--	--	--	--	--	--	5.15E-06	4.31E-04	3.75E-04
2,3,4,7,8-PeCDF	--	--	--	--	--	--	--	--	--	--	--	--	--	4.97E-06	3.35E-05	3.75E-05
1,2,3,7,8-PeCDD	--	--	--	--	--	--	--	--	--	--	--	--	--	1.14E-05	5.67E-05	1.13E-05
1,2,3,4,7,8-HxCDF	--	--	--	--	--	--	--	--	--	--	--	--	--	1.77E-05	2.29E-05	1.13E-04
1,2,3,6,7,8-HxCDF	--	--	--	--	--	--	--	--	--	--	--	--	--	1.12E-05	2.29E-05	1.13E-04
2,3,4,6,7,8-HxCDF	--	--	--	--	--	--	--	--	--	--	--	--	--	1.96E-05	2.29E-05	1.13E-04
1,2,3,7,8,9-HxCDF	--	--	--	--	--	--	--	--	--	--	--	--	--	5.74E-06	4.52E-05	1.13E-04
1,2,3,4,7,8-HxCDD	--	--	--	--	--	--	--	--	--	--	--	--	--	1.60E-05	5.30E-05	1.13E-04
1,2,3,6,7,8-HxCDD	--	--	--	--	--	--	--	--	--	--	--	--	--	1.16E-04	2.30E-05	1.13E-04
1,2,3,7,8,9-HxCDD	--	--	--	--	--	--	--	--	--	--	--	--	--	4.39E-05	2.30E-05	1.13E-04
1,2,3,4,6,7,8-HpCDF	--	--	--	--	--	--	--	--	--	--	--	--	--	1.71E-04	3.83E-04	1.13E-03
1,2,3,4,7,8,9-HpCDF	--	--	--	--	--	--	--	--	--	--	--	--	--	1.16E-05	3.83E-04	1.13E-03
1,2,3,4,6,7,8-HpCDD	--	--	--	--	--	--	--	--	--	--	--	--	--	1.81E-03	3.91E-04	1.13E-03
OCDF	--	--	--	--	--	--	--	--	--	--	--	--	--	2.79E-04	5.49E-03	3.75E-02
OCDD	--	--	--	--	--	--	--	--	--	--	--	--	--	1.22E-02	2.17E-02	3.75E-02

Yellow shading indicates 2014 concentration is HIGHER than that used in the Residual Risk Assessment
Grey shading indicates 2014 concentration is LOWER than that used in the Residual Risk Assessment
ISM Samples available for the Residual Risk Assessment included only samples from Wharf Road Area Decision Units (DU-1, DU-2, DU-3).